of 100N was applied to the elbows at 15mm/min in 15-degree intervals from 0 to 120 degrees of flexion. Posterior ulnohumeral displacement was obtained using crosshead motion data in each of 3 configurations: 1. Intact coronoid 2. Osteotomized coronoid 3. Olecranon transfer. Elbow range of motion was compared between the intact and reconstructed states. A paired t-test was used to compare differences in posterior displacement between the osteotomized and reconstructed states. **Results:** The olecranon graft provided a precise anatomic fit in all specimens, and all reconstructed specimens had full range of motion. Intact translation (mean ± SD) ranged from 0.3 ± 0.1 mm to 1.1 ± 0.6 mm, and translation in the osteotomized state ranged from 1.3 ± 1.0 mm to 2.0 ± 1.0 mm. Resection of the coronoid resulted in a significant increase in posterior ulnar translation compared with intact at all flexion angles except 75 degrees. Reconstruction decreased translation versus the osteotomized state to some extent at all flexion angles, significantly at 60 and 120 degrees of flexion. There was no significant difference in translation between reconstructed and intact states at 15, 45, 60, 90, and 120 degrees of flexion. **Conclusions:** Reconstruction of a simulated type III coronoid fracture with an osteochondral olecranon tip autograft decreased posterior ulnar translation to a level not different from the intact state at five of eight elbow positions tested. A decrease in translation compared with the osteotomized state was observed at all flexion positions. The olecranon graft provided a continuous osteochondral articular surface, and all reconstructed specimens had full range of motion.

18 COMPUTER- AND IMAGE-ASSISTED GUIDANCE SYSTEM FOR RADIAL HEAD ARTHROPLASTY

Simon R. Deluce, MSc, Hannah L. Shannon, MSc, Emily A. Lalone, PhD, George S. Athwal, MD, FRCSC, Louis M. Ferreira, PhD, ***Graham J.W. King, MD,*** *James A. Johnson, PhD, Western University and the Bioengineering Laboratory, The Roth|McFarlane Hand and Upper Limb Centre, St. Joseph's Health Care, London, Ontario, Canada*

Introduction: Previous studies have identified the importance and difficulty associated with accurately positioning radial head replacements due to the complex shape of the native radial head. Errors in implant positioning are further exacerbated when the radial head is fractured or has previously been excised. Anatomic landmarks, such as the biceps tuberosity and radial styloid, are highly variable between patients making them suboptimal for clinical use. We hypothesized that a computer and image-assisted guidance system for radial head implant positioning would lead to highly accurate positioning. **Methods:** Pre-operative computed tomography (CT) scans were obtained from eight fresh frozen cadaveric upper extremities. Using medical image processing software (Mimics, Materialize N.V., Belgium) a pre-operative surface model of the radius was generated. Custom software was developed using the Visualization Toolkit (VTK) to align this pre-operative model to an anatomic coordinate system created using manually selected landmarks and determine the ideal position for the implant stem. An active optical tracking system (Optotrak Certus, Northern Digital Incorporated, Canada) was used to obtain surface digitizations using a tracked probe and a position sensor rigidly fixed to the radius. Digitized surfaces included the accessible surface of the radial head itself, patches on the mid-shaft and distal radius. A surface-based registration between the pre-operative model and intra-operatively obtained digitizations was determined using the iterative closest point (ICP) algorithm. A custom interface was used to provide real-time visual navigation of the implants position and orientation relative to the pre-operative target. The stem was aligned to the target location and held manually in place as the cement hardened before recording its final position. The difference between the target as it appeared on the screen and the final position is the operator based navigation error. A landmark-based registration using fiducial markers provided the datum by which the accuracy of the surface-based registration was evaluated to determine the registration error. Total error quantifies the geometric sum of these two errors. **Results:**

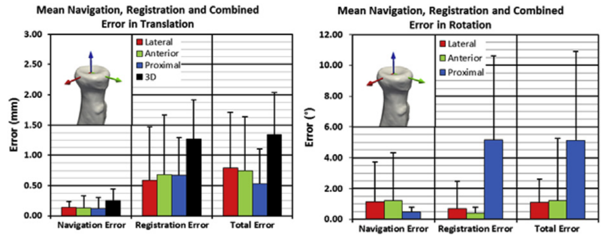

Figure 1 Mean and maximum (bars) navigation, registration and total error in translation (left) and rotation (right). Translation error included the equivalent 3D translation error (black bar).

The largest component of the total alignment error was rotation about the long axis of 5.1±3.1°. Total rotational errors about the medial/lateral (ML) and anterior/posterior (AP) axes were 1.1±0.9° and 1.2±1.7° respectively. The height mismatch was 0.5±0.3 mm. Absolute positioning errors in the ML and AP directions were 0.8±0.5 mm and 0.8±0.6 mm respectively. The navigation error incurred during manual alignment of the implant was less than the error resulting from the surface-based registration used to align the location of the pre-operative target intra-operatively. **Discussion:** The error incurred during the manual alignment of the implant was much less than that incurred by the surface-based registration particularly about the long axis of the radius. This was a foreseeable difficulty as the differences between the maximum and minimum axes of the radial head are only 1-2 mm and this difference is further obscured by the offset of the cartilage in intra-operative digitizations which is not present in imaging. This leads to a loss of rotational stability in the registration which the inclusion of mid-bone digitizations and points on the distal radius was meant to prevent. Further work is required to improve the accuracy or surface-based registration of the radius. Shortcomings of the current study include the use of complete radial head digitizations in the registered dataset and the use of ipsi-lateral imaging to generate the pre-operative plan. In the clinical application of navigated radial head arthroplasty the radial head would be damaged limiting the region available for digitization and planning. Thus in some respects the registration achieved in the current study represents a best case scenario; registration error and hence the accuracy of implant placement would likely be worse clinically using a model obtained from the contra-lateral side. Ultimately the current system represents an important first step in the development of a computer and image-assisted system for radial head implant navigation. The majority of the error can be attributed to registration rather than navigation suggesting that further improvements in registration techniques are needed. Further work is required to determine the acceptable level of surface mismatch at the radial head in order to define clinically acceptable navigation errors. **Significance:** Computer and image-assisted surgery for the radial head may improve the accuracy of positioning and hence the outcome of radial head arthroplasty.

19 ALLOGRAFT LIGAMENT RECONSTRUCTION FOR POST-TRAUMATIC ELBOW POSTEROLATERAL ROTATORY INSTABILITY: A MID-TERM FOLLOW-UP STUDY

Yaser M.K. Baghdadi, MD, Bernard F. Morrey, MD, Shawn W. O'Driscoll, MD, PhD, Scott P. Steinmann, MD, ***Joaquin Sanchez-Sotelo, MD, PhD,*** *Department of Orthopedic Surgery, Mayo Clinic, Rochester, Minnesota, USA*

Introduction: Insufficiency of the lateral collateral ligament complex (LCLC) results in elbow posterolateral rotatory instability (PLRI). Autograft tendon reconstruction has been reported to restore elbow stability in patients with PLRI. Allograft reconstructions are commonly performed to avoid the morbidity of autograft harvesting. The outcome of allograft reconstruction of the LCLC is largely unknown, and may vary depending on the integrity of other stabilizing elbow structures. The purposes of this study were (1) to determine the outcome of allograft reconstruction of the LCLC for patients with